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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:	)
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Alfredo GAMBIRASIO, *et al.*	)
	)
Serial No.: 10/550,463	) Group Art Unit: 2874
	)
Filed: September 26, 2005	) Examiner: Omar R. Rojas
	)
For: MICROSTRUCTURED OPTICAL FIBRE	) Confirmation No. 4626
	)
	)

Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

Sir:

DECLARATION UNDER 37 C.F.R. § 1.132

I, Alfredo Gambirasio, do hereby make the following declaration:

1. I have a Doctor of Philosophy degree in Physics obtained January 24, 2000 at the University of Milan.

2. I have three years experience with the manufacture of optical fibers, including two years experience with microstructured optical fibers.

3. I am currently employed as technical engineer with Pirelli Labs S.p.A. in Milan.

4. I am the first named inventor on U.S. Patent Application No. 10/550,463 ("the '463 application"), titled "Microstructured Optical Fibre".

5. At page 5, line 25 through page 6, line 6, the '463 application teaches that $\lambda_p = 2*(\rho_2-\rho_1)/(\ln(I_1/I_2))$, where

λ_p is the spatial variation length of the electric field intensity in the microstructured region;

$\rho_1 = r_{h,\,min} - \Delta_p$;

$\rho_2 = r_{h,\,max} + \Delta_p$;

$r_{h,\,min}$ is the distance between the center of the innermost microstructure and the center of the fiber;

$r_{h,\,max}$ is the distance between the center of the outermost microstructure and the center of the fiber;

Δ_p is the distance between the center of the innermost microstructure and the edge of the core region; and

I_i is the electric field intensity at the distance ρ_i computed along any radial direction.

6. I have reviewed the specification of European Patent Publication No. EP 1 118 887 A2 ("Sumitomo"). I believe that I am a person skilled in the art with respect to the subject matter disclosed in this application.

7. Sumitomo discloses a number of embodiments of an optical fiber, including a third embodiment. Within its third embodiment, Sumitomo discloses examples 4-6, 6a, and 6b. In each of examples 4-6, 6a, and 6b, Δ_Φ is 6.2 μm. Sumitomo at ¶ 79.

8. Sumitomo's ¶¶ 77-81, 88, 91, and 95 disclose a number of parameters for examples 4-6, 6a, and 6b (see also Sumitomo Fig. 14).

9. Based on these parameters, it turns out that, for each of examples 4, 5, 6, 6a and 6b disclosed by Sumitomo, $r_{h,min} = r_{h,max} = d$ and $\Delta_p = d-a$. Hence $\rho_1 = r_{h,\,min} - \Delta_p = a$

and $\rho_2 = r_{h,\ max} + \Delta_p = 2d\text{-}a$. Using the method described below, I calculated the following parameters for examples 4-6, 6a, and 6b:

Example 4 ($a = 1.37\mu m$, $d = 17.8\mu m$): $\rho_1 = 1.37\mu m$; $\rho_2 = 34.23\mu m$; $\lambda_p = 2.8\mu m$;

Example 5 ($a = 1.37\mu m$, $d = 17.8\mu m$): $\rho_1 = 1.37\mu m$; $\rho_2 = 34.23\mu m$; $\lambda_p = 2.7\mu m$;

Example 6 ($a = 1.37\mu m$, $d = 17.8\mu m$): $\rho_1 = 1.37\mu m$; $\rho_2 = 34.23\mu m$; $\lambda_p = 2.4\mu m$;

Example 6a ($a = 1.29\mu m$, $d = 17.8\mu m$): $\rho_1 = 1.29\mu m$; $\rho_2 = 34.31\mu m$; $\lambda_p = 3.0\mu m$;

Example 6b ($a = 1.27\mu m$, $d = 17.8\mu m$): $\rho_1 = 1.27\mu m$; $\rho_2 = 34.33\mu m$; $\lambda_p = 3.3\mu m$.

10. Sumitomo discloses that Δ_Φ is 6.2 μm for each of examples 4-6, 6a, and 6b. Accordingly, based on the calculations described above, the relationship between Δ_Φ and λ_p in examples 4-6, 6a, and 6b is as follows:

Example 4: $\Delta_\Phi = 2.2\lambda_{p;}$

Example 5: $\Delta_\Phi = 2.3\lambda_p$;

Example 6: $\Delta_\Phi = 2.6\lambda_p$;

Example 6a: $\Delta_\Phi = 2.1\lambda_p$; and

Example 6b: $\Delta_\Phi = 1.9\lambda_p$.

11. I am aware that independent claims 19, 32, and 36 of the '463 application each recite "the distance Δ_Φ between the centers of any couple of adjacent microstructures being at least equal to about λ_p and not higher than about $1.5\lambda_p$." As indicated in ¶ 10, the distance Δ_Φ of the examples of Sumitomo's third embodiment ranges between $1.9\lambda_p$ and $2.6\lambda_p$. In the context of the '463 application, $1.9\lambda_p$ is not "about $1.5\lambda_p$."

12. The above-described calculations of λ_p were performed at a wavelength of 1550 nm using the MIT Photonic-Bands (MPB) package (version 1.4.2) developed by Steven G. Johnson at MIT along with the Joannopoulos Ab Initio Physics group. Computational methods underlying MPB are described in Steven G. Johnson and J. D. Joannopoulos, "Block-iterative frequency-domain methods for Maxwell's equations in a planewave basis." Optics Express 8, no. 3, 173-190 (2001) (Attached hereto as Exhibit A). Using this software package, it is possible to accurately calculate the mode intensity of a microstructured fiber having an up-doped core inside a down-doped inner cladding such as those disclosed in Sumitomo's third embodiment.

13. The MPB package uses plane waves to represent the electromagnetic field. In the case of Sumitomo's third embodiment, the fiber structure is not periodic, and was therefore replicated on a lattice. In doing so, the lattice size needs to be chosen large enough that the effect of the periodic boundaries is negligible on the values of interest. In particular, a relatively small lattice size of 25 μm would be sufficient in order to calculate the effective index and dispersion of Sumitomo's third embodiment, but since it is necessary to calculate the field intensity at ρ_2 = 34.33 um off the fiber center, it was necessary to use a larger value for the lattice size. We selected a lattice size of 102.4 μm, so as to result into 1024 lattice points per side when a discretization of 0.1 μm is used. In this way, fast Fourier transforms widely used in this computational approach are optimal. Also, a smoothing of sharp boundaries between different dielectric objects, especially in the case of air holes, helps to achieve faster convergence of the method. For this purpose we used a smoothing over a mesh of 7 points. The fundamental mode

at λ = 1550 nm was also calculated using a very strict convergence tolerance of 10^{-16}. In this way the tails of the mode achieved full convergence.

14. A second approach to solving Maxwell equations for microstructured optical fibers is described in "Multipole analysis of hole-assisted optical fibers." Opt. Commun. 206, 333-339 (2002) (Attached hereto as Exhibit B). This method is suitable to solve Maxwell equations for a microstructured optical fiber consisting of simple cylindrical objects having an homogeneous index of refraction immersed in a uniform material of homogeneous index of refraction. Therefore, this method does not allow an exact calculation of the electric field and of λ_p for optical fibers having an up-doped core inside a down-doped inner cladding, such as those disclosed in Sumitomo's third embodiment. Accordingly, one may still obtain an approximate estimate of the electric field and of λ_p only by substituting the up-doped core and the down-doped inner cladding with a proper uniformly doped effective cylindrical region. Within this approximation, the intensity of the electric field is accurately evaluated in the outer cladding region only, whereas this intensity turns out to be underestimated in the effective inner region, thereby resulting in an effective spatial variation length $\lambda_{p,eff}$ which is overestimated with respect to the real value.

15. Using this method, the following ratios of Δ_Φ to $\lambda_{p,eff}$ were calculated for the examples disclosed in Sumitomo's third embodiment: Example 4, $\Delta_\Phi/\lambda_{p,eff}$ = 1.9; Example 5, $\Delta_\Phi/\lambda_{p,eff}$ = 2.0; Example 6, $\Delta_\Phi/\lambda_{p,eff}$ = 2.3; Example 6a, $\Delta_\Phi/\lambda_{p,eff}$ = 1.8; Example 6b, $\Delta_\Phi/\lambda_{p,eff}$ = 1.6. However, since $\lambda_{p,eff} > \lambda_p$, using this method one obtains underestimated values of the Δ_Φ/λ_p ratios.

16. I declare further that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further, that the statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patents issuing thereon.

Dated: October 31, 2007 By: Alfredo Gambirasio

Alfredo Gambirasio